
OFFICE OF SCIENCE & TECHNOLOGY

Characterization,
Monitoring,
& Sensor
Technologies



November 1997 Progress Reports

Reports from FY94 to present available on the CMST-CP homepage (<http://www.cmst.org>)

*Characterization,
Monitoring,
& Sensor Technology
Crosscutting Program*

*Federal Energy
Technology
Center,
Morgantown*



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CMST-CP Index

This index lists FY98 CMST-CP projects by number, name, and document location of brief descriptions of their major activities for the month. It also identifies which technologies the project involves. ("P" indicates primary involvement.)

Project Number	Project Name	Page	Subsurface Contaminants	Tanks	Mixed Wastes	D & D	Coordination
AL27C221	New Environmental Measurement while Drilling	5	P				
AL28C221	Alternative Landfill Cover Demonstration	10	P				
AL33C231	Metal Emissions Monitor for DOE Mixed Waste Thermal Treatment	25			P		
CH15C251	Portable X-Ray, K-Edge Heavy Metal Detector	27				P	
CH17C232	Real-Time Plutonium Monitoring	24			P		
CH17C233	Development of a Multielement Metal Continuous Emission Monitor for Compliance Monitoring	25			P		
CH17C261	Characterization Crosscutting Program Technical Support	34					P
CH26C217	Ultrasonic Sensors for <i>In Situ</i> Monitoring of Physical Properties	16		P			
CH27C231	Development of a Magnetic Resonance Monitor for Technetium-99 Column Breakthrough	18		P			
FIU7C202	Plant Stress Analysis Technology Transfer	29				P	
FT07C221	Southern States Energy Board—Privatization Pilot Project, Expedited Site Characterization	1	P				
HQ07C222	IAG-Air Force Development and Testing of Sonic Cone Penetrometer System		P				
ID75C221	Integrated Geophysical and Hydrological Characterization of Transport through Fractured Rock		P				✓
ID77C211	DOE Laboratory/Industry Performance Demonstration Test	22			P		
NV02C251	Associated Particle Imaging					P	
NV05C221	Environmental Remote Sensing for Monitoring Plant Health	30	✓			P	
NV05C253	Airborne and Ground-Based Laser-Induced Fluorescence (LIF)	27	✓			P	
NV06C261	Characterization Crosscutting Program Field Coordination	32					P
NV07C221	Laser-Induced Fluorescence (LIF) for Heavy Metals in Soils and Plants	28				P	
NV07C264	Current Practice of Environmental Characterization and Monitoring Technologies	11	P				
NV08C231	Integrated Raman pOH Sensor for In-Tank Monitoring	17		P			
OR17C231	Comparative Testing of Pipeline Slurry Monitors	16		P			
RL35C223	JCCM Contaminant Transport Studies (PNNL)	8	P	✓			✓
RL36C214	<i>In Situ</i> Sensor Development - Ultrasonic Density Measurement Probe			P	✓		

CMST-CP Index - continued

Project Number	Project Name	Page	Subsurface Contaminants	Tanks	Mixed Wastes	D & D	Coordination
RL37C231	Development of Process Monitors for Cesium-137 Column Breakthrough	18		P			
SF14C222	Analog Site for Characterization of Fractured Rock	7	P				✓
SF24C223	Electrical Resistance Tomography for Subsurface Imaging	15	✓	P			
SR15C223	JCCEM Contaminant Transport Studies (WSRC)		P				
SR16C221	Site Characterization and Analysis Penetrometer System (SCAPS) Logistics		P				
SR17C221	Characterization and Monitoring of Dense, Nonaqueous Phase Liquids (WSRC)		P				
SR17C231	Demonstration of Emerging Continuous Emissions Monitoring Technologies				P		

FETC Index

This index lists FY98 FETC projects by number, name, and document location of brief descriptions of their major activities for the month. It also identifies which technologies the project involves. ("P" indicates primary involvement.)

Project Number	Project Name	Page	Subsurface Contaminants	Tanks	Mixed Wastes	D & D	Coordination
AC21-92MC29101	High-Resolution Subsurface Imaging and Neural Network Recognition		P				
AC21-92MC29103	Development of a Long-Term, Post-Closure Radiation Monitor	9	P	✓			
AR21-94MC31178	A Steerable/Distance Enhanced Penetrometer Delivery System		P				
AR21-95MC31186	Measuring Fuel Contamination Using High-Speed Gas Chromatography and Cone Penetration Techniques		P				
AR21-95MC32088	Development of an On-Line, Real-Time Alpha Radiation Measuring Instrument for Liquid Streams	5	P				
AR21-95MC32089	Fiber-Optic/Cone Penetrometer System for Subsurface Heavy Metal Detection	1	P				
AR21-95MC32110	Measurement of Radionuclides Using Ion Chromatography and Flow-Cell Scintillation Counting	4	P			✓	
AR21-96MC33077	Tomographic Site Characterization Using Cone Penetrometer, Electrical Resistivity Tomography, and Ground Penetrating Radar	3	P				
AR21-96MC33079	Internal Reflection Sensor for the Cone Penetrometer		P				
AC21-96MC33124	<i>In Situ</i> Permeability Measurements with Direct Push Techniques	2	P				
AC21-96MC33125	Subsurface Barrier Validation with the SEAttrace™ Monitoring System	9	P	✓			
AC21-96MC33128	<i>In Situ</i> Tritium Beta Detector	6	P				
AC21-92MC29108	Field Raman Spectrograph for Environmental Analysis		✓	P	✓	✓	
AR21-93MC30363	Robotic End Effector for Inspection of Storage Tanks	12		P			
AR21-95MC32087	An Advanced, Open-Path, Atmospheric Pollution Monitor	13	✓	P			
AC21-96MC33126	Automated Monitoring System for Fluid Level and Density in High-Level Waste Tanks	14		P			
AC21-92MC29115	Intelligent Inspection and Survey Robot	23			P	✓	
AC21-93MC30173	Waste Inspection Tomography	21	✓		P	✓	
AC21-96MC32194	A Continuous Emission Monitor for Toxic Metals in the Offgases of Thermal Treatment Facilities				P		
AC21-96MC33127	Nondestructive Examination and Assay of Drums Containing Transuranic Waste	21			P	✓	

FETC Index - continued

Project Number	Project Name	Page	Subsurface Contaminants	Tanks	Mixed Wastes	D & D	Coordination
AC21-93MC30172	Characterization for Radioactive Contamination Inside Pipes with the Pipe Explorer™ System		✓			P	
AC21-93MC30175	Portable Sensor for Hazardous Waste		✓		✓	P	
AC21-93MC30176	3-Dimensional Integrated Characterization and Archiving System (3D-ICAS)		✓		✓	P	
AC21-94MC31190	Coherent Laser Vision System				✓	P	
AR21-95MC32093	Diagnostics and Data Fusion of Robotic Sensors					P	
AR21-95MC32115	Multisensor Inspection and Characterization Robot for Small Pipes (MICROSPI)					P	

Monthly Highlights

This section summarizes some of the most significant progress achieved within the CMST area during the reporting period. More information about each project can be found on the page indicated within each summary.

- **Three-Dimensional Integrated Characterization and Archiving System (3D-ICAS)**
The 3D-ICAS was successfully integrated with mobility platforms at Oak Ridge National Laboratory (ORNL). The system was then demonstrated at the ORNL Robotics and Process Systems Division. The demonstration consisted of mapping the wall unit (purposely contaminated with low levels of organic materials, alpha emitters, and a beta emitter), displaying the map, selecting points to be surveyed, running the contaminant survey, displaying the measured contamination in real time, and displaying detailed spatial and contamination data after the survey was completed. (Page 24)
- **Tomographic Site Characterization Using Cone Penetrometer, Electrical Resistivity Tomography (ERT), and Ground Penetrating Radar (GPR)**
The ERT and GPR prototype equipment and survey crew were deployed to Savannah River Site, where cross-hole measurements and preliminary cross-hole images were made. This field deployment at a DOE site was successful. (Page 3)
- **Fiber-Optic/Cone Penetrometer System for Subsurface Heavy Metal Detection**
Field testing of the laser-induced breakdown spectroscopy (LIBS) penetrometer system was conducted in Albuquerque. Also, LIBS surface analysis using a prototype backpack and van-mounted system was conducted in Luckey, Ohio. (Page 1)
- **Characterization, Monitoring, and Sensor Technology Cost Savings Analysis**
The CMST-CP began a collaborative effort in August with the Office of Science and Technology cost savings teams (i.e., U.S. Army Corps of Engineers and University of North Dakota Energy and Environmental Research Center) to document cost savings from use of innovative technologies. Ten characterization and monitoring technologies with significant cost savings potential were identified. A team consisting of a CMST-CP technical expert and members of one of the two cost savings teams conducted each cost savings analysis. Eight draft reports are complete; two technologies were determined to be ineligible for completion. The draft reports are being reviewed by individual sites for consideration of incorporating them into the 2006 Plan. Additionally, corresponding innovative technology summary reports are planned for FY 1998 publication. (Page 33)
- **Analog Site for Characterization of Fractured Rock**
The fourth and final pulse of the infiltration test at the Box Canyon site was conducted. (Page 8)

Monthly Highlights - continued

- **Environmental Remote Sensing for Monitoring Plant Health (EPCOT)**
The first experiment to determine the effects of light-dark cycles on fluorescence signatures in plants began in the environmentally controlled lab at The Land in the EPCOT Center. Fluorescence spectra from several crop species that have been dark adapted for hours will be compared to spectra from fully illuminated plants. In addition, the first harvest of the bean/zinc experiment was conducted. (Page 31)
- **DOE Laboratory/Industry Performance Demonstration Test**
The first session of the project was completed in October. The Bio-Imaging Research Waste Inspection Tomography (WIT) system completed assay of four sample drums and two Performance Demonstration Program drums. The Canberra Industries Segmented Gamma Scanner (SGS) was able to complete all the test samples. The first interim report is being prepared. (Page 19)
- **Waste Inspection Tomography (WIT)**
WIT completed the Capability Evaluation Program and Performance Demonstration Program tests at Idaho National Engineering and Environmental Laboratory for the active and passive computed tomography assay precision testing. These ongoing tests are “blind” for other systems still being tested or yet to be tested. Accuracy will be known after the public scoring disclosure from test authorities in the near future. (Page 17)
- **Associated Particle Imaging (API)**
The final report on the Nevada Test Site field demonstration is complete. The results of the Area 5 tests on both known and unknown waste drums were encouraging. The “Lynchburg standard” drum survey showed distinct objects. The survey of the unknown drum showed a strong distributed signature of the expected material in the lower section of the drum, but no resolvable shapes. A strong oxygen signature was also detected. The conclusions are that the contents are in the form of small pieces, are distributed through the lower part of the drum, and are probably highly oxidized. (Page 26)

Subsurface Contaminants

Plumes

Expedited Site Characterization

Southern States Energy Board—Privatization Pilot Project, Expedited Site Characterization

Objective

This project will focus on developing specific mechanisms to gain wide-scale use of Expedited Site Characterization (ESC). These mechanisms include:

- Establishing working agreements with the Southern States Energy Board (SSEB) Industry Affiliates group, a coalition of major manufacturers and potential users in the Southeast region
- Conducting forums and training for multi-state regulatory acceptance
- Using the SSEB team's expertise in forming investment partnerships (such as with the insurance industry) to finance the use of ESC in private-sector activities, e.g., site/land conversions

Progress

The Southern States Energy Board will hold a roundtable entitled "Best Practices in Environmental Liability Restructuring, Mechanisms for Privatization of Expedited Site Characterization" on January 22 in Atlanta. Participants, by invitation only, will include insurance firms, technology developers, engineering firms, and large manufacturers.

PI: Andy Paterson, Southern States Energy Board, (619) 295-7685 x 26

Field Analysis

Fiber-Optic/Cone Penetrometer System for Subsurface Heavy Metal Detection

Objective

This effort will develop a fiber-optic, laser-induced breakdown spectroscopy (LIBS) sensor and cone penetrometer system for subsurface detection and analysis of heavy metals. A rugged, small-sized, multianalyte sensor system will aid in characterizing and remediating contaminated land sites by reducing costs and analysis time.

The base phase involved the design, construction, and evaluation of fiber-optic probes and simulated penetrometer configurations to prove feasibility of the concept for analysis of soil samples. Probes were evaluated for their ability to perform quantitative analysis of Cr and Pb (or other DOE-specified elements). The option, in progress, will consist of fabricating an integrated, rugged LIBS/penetrometer system to be tested in the laboratory and at a DOE field site.

Progress

Site characterization at Luckey, Ohio, was completed. An interim report on the Luckey activities is being prepared. Options for a continuation of the penetrometer effort were developed. A laboratory analysis with Energy and Environmental Research Center samples for software development was conducted.

PI: Stephen Saggese, Science & Engineering Associates, (505) 884-2300

FETC COR: Karen Cohen, (412) 892-6667

Geophysical/Hydrologic Characterization

In Situ Permeability Measurements with Direct Push Techniques

Objective

This project will develop the measurement model, perform validation in the laboratory, and conduct a field test of a prototype *in situ* permeability measurement system integrated with direct push techniques such as cone penetrometers. This effort involves two major thrusts: development of a measurement model that will perform in the cone penetrometer operating environment and engineering the measurement package to satisfy the size and operational constraints of penetrometer applications.

Progress

The data acquisition program was completed, and its operation checked with the signal simulator. The instrument package assembly was 90% completed. Specifications for the design of the cone penetrometer (CPT) probe were forwarded to Wes Bratton of Applied Research Associates. In preparation for the laboratory tests with the prototype CPT probe, we tested several sand/silica flour mixtures and selected a formulation that will provide a low permeability test (nominally 1 Darcy or less). Bulk quantities of the sand and silica flour were ordered to fill the approximately 4-foot square test cell. Discussions continue with Savannah River personnel regarding the test demonstration.

PI: Bill Lowry, Science and Engineering Associates, (505) 424-6955

FETC COR: Karen Cohen, (412) 892-6667

Tomographic Site Characterization Using Cone Penetrometer, Electrical Resistivity Tomography, and Ground Penetrating Radar

Objective

This project will develop a ground penetrating radar (GPR) cone penetrometer (CPT) cross-hole measurement system for tomographic imaging and will also jointly develop an electrical resistivity tomographic (ERT) cone penetrometer cross-hole measurement system with Lawrence Livermore National Laboratory (LLNL). These new cone penetrometer systems will be used for better subsurface site characterization and monitoring at hazardous waste sites. Integrating GPR and ERT with cost-effective cone penetrometer technology will greatly reduce the costs associated with site characterization and long-term environmental monitoring. At the end of this project, the DOE will be able to perform GPR and ERT cross-hole imaging using the cone penetrometer to install GPR antennas and ERT electrodes.

Progress

During November, activities focused on field testing. Specific activities were as follows:

- The cross-hole ERT and GPR data from the MWD Hydro test site at Savannah River Site (SRS) were successfully processed.
- The GPR tomographic data were processed, creating three different types of tomograms. These include velocity, attenuation, and conductivity tomograms between six hole-pairs. The GPR results compare favorably with the CPT soil characterization and resistivity logs. From the GPR results, we are able to delineate soil stratigraphy, map sand and clay layers, and indicate variations in soil moisture content (as per the statement of work).
- Processing the ERT tomographic data is proving to be difficult; however, we are producing reasonable tomographic images of resistivity variations.
- Planning was completed on the second deployment to a DOE site. The site chosen is the 321-M Solvent Storage Tank area in the M-Area at SRS. This site contains dense nonaqueous phase liquid (DNAPL) contamination and is well characterized from drill holes and CPT pushes.

PI: Rexford Morey, Applied Research Associates, (802) 763-8348

FETC COR: Karen Cohen, (412) 892-6667

Measurement of Radionuclides Using Ion Chromatography and Flow-Cell Scintillation Counting with Pulse Shape Discrimination for ER/WM Applications

Objective

This effort will develop laboratory techniques for measuring radionuclides by using ion chromatography for elemental selectivity and flow-cell scintillation counting with pulse shape discrimination for isotopic selectivity. The radionuclides measurement methodology developed by this work will facilitate performance of on-line counting of both aqueous and nonaqueous samples at minimum detectable concentrations (MDCs) that are well below requirements for waste samples and are low enough for environmental screening. When coupled with off-line counting, MDCs would approach typical regulatory limits. The project will be implemented in two parts: a base program and an option. In the base program, the contractor will focus on sample preparation and radiation detection components for developing the ion chromatography/on-line scintillation counting for environmental/waste samples.

Progress

Flow-cell scintillation detector development. Work continued toward developing a new, durable plastic cell that will not leak and will achieve a lower background count rate than the previous glass cell. A previously fabricated plastic cell proved susceptible to leaching, but demonstrated a count rate of 0.53 counts per second in the full window for the cocktail Ultima Gold AB as opposed to 0.78 counts per second for the glass cell.

Development of the digital, dual parameter data acquisition system continues. The hardware and software were installed and work properly. Preparation of CsI(Tl) for Parylene C coating is in progress.

Development of sample processing protocols. The optimization of sample preparation protocols using element-specific resins for their efficacy in concentrating the actinides and strontium continued. The effectiveness of the sample preparation protocols on processing a spiked soil sample, representative of the soils at the Savannah River Site, is being evaluated.

PI: Angela Harrington, South Carolina Universities Research and Education Foundation, (864) 656-5569

FETC COR: Jagdish Malhotra, (304) 285-4053

Development of an On-Line, Real-Time, Alpha-Radiation Measuring Instrument for Liquid Streams

Objective

Phase 1 involved the design, development, and testing of a laboratory-scale instrument. Testing will initially be conducted using standard aqueous uranium and other low-level radioactivity solutions. Further laboratory testing will simulate field test conditions by using samples obtained from selected DOE sites. In phase 2, the phase 1 instrument will be scaled up and field tests will be performed at selected DOE sites to demonstrate the suitability of the device to detect and measure uranium and other radionuclide concentrations under field conditions. Surface, ground, and process waters will be tested.

Progress

As reported last month, a commercialization plan that maps out a strategy for the planned commercial introduction of the resultant instrument was submitted. This month, comments on this draft plan were returned to the contractor for incorporation into a final report. Preparation of a commercial prototype analysis, design, and costing report continues. A final field test plan was submitted, and coordination with another Oak Ridge National Laboratory (ORNL) project will result in the use of the Thermo alpha monitor (TAM) for monitoring groundwater during drilling for a pump and treat operation.

The PI continues to investigate interest in the technology, which has wide application across the DOE complex, as well as private industry, in detection, remediation, and long-term monitoring of alpha radiation from various water sources. The U.S. EPA and the Colorado state EPA have expressed interest in use of the TAM at Rocky Flats and at a waste water treatment plant. There has also been some interest in adapting the instrument for beta detection.

A field demonstration at areas outside ORNL will begin in February in coordination with another ORNL pump and treat project.

PI: Keith Patch, Thermo Power Corp. (Tecogen Division), (617) 622-1400

FETC COR: Richard Bush, (412) 892-6426

New Environmental Measurement while Drilling

Objective

This project has demonstrated a radiation sensor and will provide additional sensing capabilities to an operational Environmental-Measurement-While-Drilling (EMWD) platform. Specific sensors for integration include a magnetometer for continuous distance and depth measurement capability as well as a heavy metal sensor.

Progress

The modified EMWD system including the magnetometer, an array of three accelerometers, and continuous distance measurement capability was successfully demonstrated at the Charles Machine Works (CMW) testing range. The system gives precise positioning information by providing pitch, roll, and azimuth, that is, it provides position in the x, y, z direction and distance (d). The redesigned data acquisition system simultaneously recorded the output from the magnetometer, accelerometers, and gamma spectrometer. As a verification of our capability, we also collected data from a walk-over survey using the CMW-Subsite beacon to determine depth and pitch. We placed markers in the ground at each beacon data point and had a survey conducted of these positions. We are comparing the Subsite and survey data with our position data.

We are working to identify a partner site for the “Hot Site” demonstration. We made an initial contact with Hanford ER, who may have an interest in using the technology. We are also making contacts with Savannah River Site and Oak Ridge National Laboratory.

We are proceeding into Patent Cooperation Treaty-Chapter II, which results in an examination report.

PI: Cecelia Williams, Sandia National Laboratory-Albuquerque, (505) 844-5722

In Situ Tritium Beta Detector

Objective

This task will design, develop, demonstrate, and deliver a monitoring system capable of detecting and quantifying tritium *in situ* in ground and surface water and in water from effluent lines prior to discharge into public waterways. This tritium beta detector will be a compact, immersible sensor; have a large wetted sensor surface area; possess high sensitivity and high specificity to tritium; have a near real-time response; be rugged; and contain integrated electronics.

In the base contract, the contractor will develop a set of target specifications and an engineering design of a system to meet those specifications. In option 1, the contractor would build the subscale prototype designed in the base contract and evaluate its performance in a set of controlled laboratory tests. In option 2, the contractor would build a final prototype and demonstrate the performance of the system at a DOE or representative test site.

Progress

All work under phase 1 was completed. A draft topical report was delivered to the DOE for review and comment. FETC will use this and other data to determine whether continuation into the second phase is warranted. It is clear that McDermott Technologies is not ready to build a prototype instrument, as the objective performance specifications have not yet been met. Any further activity on the project would initially focus on extending phase 1 development to find suitable scintillating optical fibers that will give the desired sensitivity to tritium beta. A continuation decision should be reached by early March.

PI: John Berthold, McDermott Technologies, (330) 829-7271

FETC COR: Ron Stauby, (304) 285-4991

Contaminant Transport

Analog Site for Characterization of Fractured Rock

Objective

This project will develop a suite of reliable tools and methodologies that can be used for characterizing flow and contaminant transport in fractured rock. The work will focus on the Idaho National Engineering and Environmental Laboratory (INEEL) site and will include development of a conceptual model for flow and transport in the fractured basalts of the sole-source Snake River Plain Aquifer there. Of the specific technologies and methodologies being developed and investigated, many will be applicable at every contaminated site and some will have to be modified for use in a different geology.

Progress

Infiltration test at Box Canyon. In early November, we completed the fourth and final pulse of the infiltration test at the Box Canyon site. This test is the subject of the companion EM Science "Chaos" project, which is also supporting the Box Canyon field work.

Data analysis. Work continued on analyzing data collected during the FY97 ponded infiltration test at Box Canyon.

Features of note from the tracer arrival data include:

- Tracer was observed in wells T-5 and T-6 in the 1997 infiltration test, whereas in the 1996 test, both wells were dry, that is, produced no water samples at all.

Continued

- The concentrations at a depth of 0.3 m in well I-1 are less than 100 mg/l, whereas the concentrations at a depth of 1.5 m are on the order of 1,000 mg/l. This is in contrast to last year, when concentrations greater than 500 mg/l were observed at both depths.

Articles. Preparation and review of journal articles summarizing the results of the project continued.

PI: Christine Doughty, Lawrence Berkeley National Laboratory, (510) 486-6453

JCCEM Contaminant Transport Studies (Pacific Northwest National Laboratory)

Objective

This project is part of a Joint Coordinating Committee for Environmental Restoration and Waste Management (JCCEM) effort on contaminant transport studies. Participants include Pacific Northwest National Laboratory (PNNL) and Westinghouse Savannah River Co. (WSRC). Program objectives include:

- establishing a mechanism for joint collaborative investigations between U.S. and Russian scientists.
- reviewing and studying data from Russian and American sites appropriate for joint coordinated activities on contaminant transport issues relevant to the needs of the DOE in developing, refining, and implementing U.S. contaminant transport models.
- publishing Russian results in English, organizing workshops to disseminate Russian information to U.S. scientists, and promoting binational cooperation.

Progress

Mike Foley, Charlie Cole, and Mark Williams attended the JCCEM workshop in Washington, D.C., November 10 to 12. We finalized the Russian part of our FY98 joint modeling plan with our Russian counterparts.

We continued digitizing the Mayak site characterization data received in September as well as conversion of all of our Mayak GIS coverages to be used in modeling to the Russians' Mayak plane coordinate system.

PI: Michael Foley, Pacific Northwest National Laboratory, (509) 372-4671

Landfills

Containment

Subsurface Barrier Validation with the SEAttrace™ Monitoring System

Objective

This effort will develop and demonstrate an integrated methodology and field system to evaluate the integrity of *in situ*, impermeable barriers constructed in the vadose zone. The methodology relies on the predictable process of binary diffusion of a tracer in the soil gas. A known concentration of tracer gas would be placed on one side of the barrier wall and soil gas samples would be drawn from known locations on the other side. Using inverse modeling methodology, the history of soil gas concentration at the various sampling locations allows determination of the leak location and its size.

Progress

Data analysis was completed, and six copies and an electronic version of the phase 1 draft topical report were transmitted to FETC. The report is being reviewed.

PI: Bill Lowry, Science and Engineering Associates, (505) 424-6955

FETC COR: Karen Cohen, (412) 892-6667

Post-Closure Monitoring

Development of a Long-Term, Post-Closure Radiation Monitor

Objective

This project is designed to develop a low-cost, multi-point radiation monitoring system for long-term, continuous monitoring of radiation levels in the vadose zone of hazardous waste sites. Based on gamma spectroscopy, the system will be able to monitor to depths of more than 50 meters without the necessity of drilling wells. The system will be capable of nearly unlimited numbers of completely passive, permanently installed probes. None of its electronic components will be belowground, and a single, aboveground optoelectronics unit will be capable of multiplexing a large number of independent probes via optical fibers. This combination will form a system not commercially available now. In phase 1, McDermott Technologies configured a system from commercial components that could monitor radionuclides in soil to pCi/g levels. The project is in phase 2.

Progress

All of the hardware was received; a new version of the software that eliminates some of the remaining bugs was also received and is operating. All laboratory testing was completed. The field trial test plan will be issued in December. Oxford Instruments personnel will be present at the site, at their cost, to assist as required during installation and subsequent system checkout.

PI: Stuart Reed, McDermott Technologies, (330) 829-7350

FETC COR: Jagdish Malhotra, (304) 285-4053

Alternative Landfill Cover Demonstration

Objective

The Alternative Landfill Cover Demonstration (ALCD) is a large-scale field test at Sandia National Laboratory. Two baseline covers (traditional Resource Conservation and Recovery Act subtitle 'D' for municipal landfills and traditional Resource Conservation and Recovery Act subtitle 'C' for hazardous mixed waste landfills) are constructed side-by-side with four alternative cover designs for comparison based on performance, cost, and ease of construction. The covers are being monitored for all water balance variables and supporting data. This field-obtained data will be compared with results obtained from predictive computer models for validation of the models. In addition, five years of water balance data would be deemed adequate for regulatory approval of the alternative covers, and this project is expected to complete data collection by the year 2001.

Progress

Project history. The ALCD is in its second year of monitoring. Data are being collected both manually and by automation. The automated data acquisition system requires monitoring to ensure it is working correctly and data retrieval for analysis. This is continuing. Manual data collection involves checking back-up systems to the automated system to ensure correct data and also involves obtaining biomass, leaf area index, and transacts studies on vegetation. This information is used to correlate with evapotranspiration and erosion effects. This is done on a constant periodic basis. Currently, we collect data for a month and then analyze it. At the end of the year, we compile it and draft an annual report.

Status. We continued to collect both manual and automated data. All systems are working as designed. We just finished collecting biomass and transact data on the test covers and vegetation plots. This is a lengthy process that takes a couple of weeks to complete. It is performed seasonally. We are finishing reports outlining the data

quality management plan for the ALCD, a cost comparison between the different covers, and a report outlining the construction for the six test covers.

PI: Steven Dwyer, Sandia National Laboratory, (505) 844-0595

Current Practice

Current Practice of Environmental Characterization and Monitoring Technologies

Objective

This project will document current practices of environmental technologies in the areas of site characterization and waste/processing monitoring. This activity will (1) collect, assess, and compile information from technology users and purchasers in DOE and EPA environmental management programs and (2) produce a database for technology users, purchasers, and project sponsors. The interactive database will be published on the Internet. Additional technologies used in other federal programs (i.e., the DoD, DoC, and DoI) as well as at private company sites will be included in the out-years.

Progress

The development of a database to be converted to an interactive database available over the World Wide Web began. A search for DOE site documents with information relevant to the survey was initiated. Information will be placed in the database to minimize the time and effort required by site users to complete the survey information.

PI: Stephan Weeks, Special Technologies Laboratory, (805) 681-2262

High-Level Waste Tanks

Safe Storage

Robotic End Effector for Inspection of Storage Tanks

Objective

This effort will develop and demonstrate a robotic tank inspection end effector (RTIEE) capable of both visual and nondestructive evaluation (NDE) of the interior walls of stainless steel and carbon steel waste storage tanks. It will detect and size corrosion damage caused by surface pitting in stainless steel and carbon steel tank walls. This system will be based on an alternating current field measurement (ACFM) technology that provides remote operator video data and indicates wall corrosion. The inspection robot operator will be presented with a graphical ACFM appraisal of the condition of the scan area on the video monitor.

In phase 1, the contractor defined end effector system requirements to include designing, fabricating, assembling, and testing the pre-prototype system at a robotic lab configured to simulate representative manipulators. Software development work is compatible with the Generic Intelligent System Control (GISC).

Progress

FETC issued a technical direction letter to align the project priorities with the current technology needs across the DOE complex. The top priority is completion of the radiation-hardened RTIEE, culminating in its delivery to Idaho National Engineering and Environmental Laboratory (INEEL). Remaining project resources were allocated to achieve the updated project objectives. The planned effort on the wall thickness sensor was rescheduled to support completion and delivery of the RTIEE. Completion of the Savannah River sampling tool is to be supported using a portion of the resources originally allocated to the wall thickness and standoff sensor breadboard development.

Regarding the RTIEE, the radiation-hardened scanner frame assembly was reconfigured for fly-by testing with the Puma manipulator. Test results indicate that the new array's output is consistent with the prior generation tank-ready prototype. The array is being tested using machined slots, calibrated fatigue cracks, and pits in the carbon and stainless steel sample plates. Additional plates with electrical discharge machining (EDM) slots are being produced to provide more known defect samples for use during NDE performance evaluation testing at Oceaneering Space Systems. The printed circuit card for the revised at-tank electronics needed to support the camera and upgraded short circuit protection was ordered. Design of the updated RTIEE back plate that mates to the INEEL tool interface plate (TIP) was completed, and manufacturing is scheduled to begin in December.

The subcontractor, Technical Software Consultants, was authorized to proceed with the design and manufacture of the standoff sensor system for the RTIEE scanner frame. Design of the printed circuit card and mechanical package was completed. Delivery of the complete system including three standoff sensors, radiation-hardened electronics, and firmware is scheduled for late December. Integration and testing of the RTIEE with the new standoff sensor is scheduled for January.

The design, manufacturing, and in-house testing of the Tank 16 annulus sampling tool were completed. The equipment was shipped, on schedule, to the Savannah River Site (SRS) in preparation for a cold test on December 3. In response to a request by SRS, a camera was added to the long-reach pole to provide a view of the work site using the single riser access port.

PI: Tom Gaseor, Oceaneering Space Systems, (713) 488-9080 ext. 3208

FETC COR: Maria Vargas, (304) 285-4617

An Advanced, Open-Path, Atmospheric Pollution Monitor for Large Areas

Objective

This effort will develop and test a novel thermal emission/laser absorption (TELA)-based instrument capable of long-range (up to 4 kilometers) measurement of atmospheric emissions. The work will be performed in the base contract and two options. In the base contract, the contractor will analyze system performance; develop a detailed design; and fabricate, assemble, and perform laboratory testing of a pre-prototype TELA monitor. In option 1, validation testing of the TELA monitor will be performed at a DOE site. In option 2, the contractor will field test the TELA monitor at the DOE Hanford site.

Progress

Analytes and calculations. A poster paper was presented at the “Industry Partnerships to Deploy Environmental Technology” symposium. The complete paper was submitted to the FETC conference organizers. The paper includes system performance estimates for both the laser absorption and thermal emission capabilities of the monitor.

Software development. The software was written to control the mechanical movement of the system and to receive data from the various detectors and subsystems such as the meteorological station. However, there is apparently a communication problem between the control computer and the motors that control the steering mirror.

Subsystem fabrication. There has been difficulty in receiving three key items: the laser oscillator, the room temperature detector, and the frequency synthesizer for the acousto-optic tunable filter (AOTF). After a five-month delay, the laser oscillator was

received, but has not been tested for power and mode quality. The frequency synthesizer was also just received. The manufacturer of the room temperature detector was redesigning the detector and encountered unexpected difficulties. Oriel Instruments, who markets the detector, indicated that they can't deliver the detector unit. Because there is no other room temperature detector with the advertised sensitivity of the Oriel detector, Northrop Grumman will try to measure the laser pulse energy with the Judson HgCdTe detector in the receiver.

The diamond-turned 4-inch (minor axis) elliptical scrapper mirror was received from II-VI. A few aluminum supports and optical mounts will be fabricated by Latrobe Tooling Specialists, the same company that fabricated some earlier parts, including the enclosure for the spare AOTF.

PI: Lyle Taylor, Northrop Grumman (Westinghouse), (412) 256-1650

FETC COR: Maria Vargas, (304) 285-4617

Automated Monitoring System for Fluid Level and Density in High-Level Waste Tanks

Objective

This project will develop a real-time continuous monitoring system of waste fluid levels and fluid densities in DOE waste tanks. The system will consist of a string of small piezoelectric elements placed inside an existing liquid observation well (LOW). A small force will be exerted on the tank wall, consequently producing sound waves that will be detected by the piezoelectric elements and multiplexed to provide real-time information on the tank waste fluid level and fluid density. In the base contract, a prototype was designed, fabricated, and tested in the laboratory. In option 1, information gained from the laboratory testing will be used to modify the design to produce a full-scale system that will then be deployed in a LOW for long-term monitoring.

Progress

The decision was made to continue this project into the option phase: development and testing of a field-deployable prototype instrument. The contract is being modified to include this option phase work. The next order of business will be for FETC and the CMST-CP to determine if development of the acoustic-based, tank-level sensor should also be pursued for the Slurry Mix Evaporator tanks application in the Savannah River Defense Waste Processing Facility (DWPF).

The phase 2 kick-off meeting is scheduled for January.

PI: David Cremer, Science and Engineering Associates, (505) 884-2300

FETC COR: Ron Staubly, (304) 285-4991

Waste Retrieval

Electrical Resistance Tomography for Subsurface Imaging

Objective

We are using electrical resistance tomography (ERT) to map changes in formation water content caused by the subsurface processes of electrokinetic remediation and leaks from waste storage tanks. This project has three technology development tasks. The first is development, demonstration, and technology transfer of ERT for monitoring leaking tanks. If successful, it will go to a full-scale demonstration on an underground storage tank (UST) during sluicing operations with UST Focus Group sponsorship. The second task is to extend the data processing algorithms to fully three dimensions. The third task is to finish reduction, analysis, and reporting on the detection of dense nonaqueous phase liquids (DNAPLs) and to clean up DNAPL-contaminated soil from the test soil tank at the Oregon Graduate Institute (OGI) Large Experimental Aquifer Program (LEAP) tank facility. Lawrence Livermore National Laboratory (LLNL) will coordinate all tasks.

Progress

A draft of the electrical impedance tomography (EIT) paper was written. We compared the results from two EIT codes—one written by Doug LaBrecque (Steam Tech) and the other written by Andrew Binley (University of Lancaster, UK). The two codes behave very much the same. We also compared the inversions from these codes with those from the frequency effect and those from a linearized perturbation analysis. In all cases, the fully generalized EIT codes were superior in sensitivity and resolution. Work continues on this paper with plans for journal submission by the end of January.

We have had a subcontract with Doug LaBrecque for several years to help with ERT and EIT code development. During this time, he has been at either the University of North Carolina or the University of Arizona. During the same time period, we have also been helping Steam Tech, a geophysical service company in Bakersfield, California, which is using ERT to monitor a steam flood remediation of DNAPL. Recently, Doug left the University of Arizona and took a position with Steam Tech to help them with the ERT steam monitoring project and to expand their ability to market ERT technology. Doug's move to Steam Tech is an important step in making ERT commercially available because it imports expertise in the field that was previously lacking into the commercial market. From this move, we will see an upturn in the commercial use of ERT.

PI: Bill Daily, Lawrence Livermore National Laboratory, (510) 422-8623

Ultrasonic Sensors for *In Situ* Monitoring of Physical Properties

Objective

This project will develop ultrasonic sensors for *in situ* monitoring of physical properties of radioactive tank waste. The initial focus is on developing sensors for fluid viscosity and volume-percent of solids measurements. The sensors will apply mainly to waste transport lines for on-line characterization. The task is to examine the feasibility of measuring fluid shear impedance to determine viscosity and measuring scattering cross-sections of ultrasonic waves to determine solid concentration. The feasibility of the impedance technique is on the issue of low-viscosity (<30 cP) measurement because the technique has been well demonstrated in the high-viscosity (>1,000 cP) range. The concept of determining solid concentration from scattering cross-section measurement is a new approach and requires a thorough study.

Progress

We continue to develop a more reliable ultrasonic technique for measuring solid concentration based on ultrasonic attenuation measurement. A solid/liquid slurry facility is being contracted for evaluating the ultrasonic flow instrument under dynamic conditions.

The PI reviewed and made comments on the performance of the ultrasonic flow instrument presented in the comparative evaluation test report by Oak Ridge National Laboratory.

PI: Shuh-Haw Sheen, Argonne National Laboratory, (630) 252-7502

Comparative Testing of Pipeline Slurry Monitors (Oak Ridge National Laboratory)

Objective

This project will demonstrate, test, and evaluate slurry monitoring instruments that are commercially available and those being developed for the CMST-CP, the Tanks Focus Area (TFA), and the Oak Ridge National Laboratory (ORNL) Waste Management organization (an EM-30 entity). The project is being jointly directed by ORNL and Ames Laboratory under separate technical task plans (see CH1-7-C2-31).

Progress

Review comments on the draft report issued in October were received and are being incorporated into the report. Pacific Northwest National Laboratory (PNNL) personnel reported that the data collected with their pipeline densitometer at 50°C needed adjustment because the instrument collected data at 50°C, but used calibration data for 25°C to interpret the data. This caused the bias and variance for the instrument to be larger than actual. PNNL personnel reanalyzed their data to adjust the density values

collected at 50°C, and they requested that ORNL modify the report to incorporate the revised data.

The design of the slurry monitoring system for FY98 activities began. We were not notified as to which instruments the CMST-CP would like to include in the test program, but the system is being designed so that any of them can be incorporated.

PI: Tom Hylton, Oak Ridge National Laboratory, (423) 576-2225

Waste Sampling/Analysis

Integrated Raman pOH Sensor for In-Tank Monitoring

Objective

This project will design, assemble, and deploy an *in situ* monitor for corrosive species in DOE's large-scale waste tanks. The base phase of the program includes a series of tests designed to establish the feasibility of a fiber-optic Raman sensor to detect anions of interest at concentrations typically found in the tanks. Materials proposed for use in the tanks will be evaluated under conditions of elevated pH, temperature, and radiation. Lastly, the requirements and preliminary design for a liquid sampling system compatible with both the Raman probe and existing tank deployment hardware will be developed in the base program. Follow-on work will include assembly of a fully functional instrument and deployment in real waste tanks.

Progress

This project is in its second month. All equipment needed for the Raman feasibility tests was setup, and testing is in progress. Initial experiments are directed at determining minimum detectable concentrations and linear dynamic range for individual corrosive anions such as nitrate and nitrite. The tests are being run with short and long lengths of optical fiber. We completed a preliminary detection limit study at short fiber lengths for the anions. We will conduct linear dynamic range and long fiber experiments next month.

PI: John Haas, EIC Laboratories, (617) 769-9450

Process Monitoring

Development of Process Monitors for Cesium-137 Column Breakthrough

Objective

This project will optimize an inexpensive, highly reliable, near real-time monitoring system for the specific detection of ^{137}Cs in the effluent from an ion exchange column. A matched pair of radiation detectors will be used to monitor activity in the effluent stream at two locations separated by a short span of time.

Progress

The major effort this month was continuing software development for data acquisition/reduction. Additional effort was applied to fabrication of the collimators and their interface with the data acquisition system. A paper describing the current state of the technology development was prepared, incorporating referee comments, and submitted to the *Journal of Radioanalytical and Nuclear Chemistry* for publication.

PI: Ron Brodzinski, Pacific Northwest National Laboratory, (509) 376-3529

Development of a Magnetic Resonance Monitor for Technetium-99 Column Breakthrough

Objective

This task will develop and implement a real-time, on-line monitoring system for ^{99}Tc . This system will be based on magnetic resonance spectroscopy of the ^{99}Tc nucleus. The sensor will be based on the Argonne National Laboratory (ANL) on-line, flow-through magnetic resonance sensor technology that is being developed for on-line sensing and quantification of organic components.

The spectrometer will incorporate a permanent magnet, a highly miniaturized electronic package, an intelligent operating system, a remote setup and operation panel, and be completely enclosed in a short 19-inch National Electrical Manufacturers Association (NEMA) 4 instrument rack. This technique will provide a real-time (milliseconds), nonradiometric sensing method capable of operating in a high-radiation environment, with immunity to contaminants, on high-pH solutions, and in high dissolved salt levels. In addition to the areas of tank waste processing, this sensor system will prove valuable in other waste processing technologies.

Progress

We continued a series of nuclear magnetic resonance (NMR) studies on two waste materials received from Hanford. These wastes include supernatant liquid from tank 241-AW-101 and a complexant concentrate sample from tank 241-AN-107. We are awaiting the conventional laboratory analysis from Pacific Northwest National Laboratory. Further studies will be performed in upcoming months.

In addition to these tank wastes, we are also performing experiments on a Tc(IV) “standard” provided by Norm Schroeder (Los Alamos National Laboratory). This material is thought to be approximately 1 millimolar in ^{99}Tc . The sample was prepared by reducing pertechnetate in the presence of EDTA as a complexing agent. It is thought that this reaction leads to a variety of compounds including an EDTA-Tc(IV)-Tc(IV)-EDTA complex. The stability of this complex is not known, although it will certainly oxidize back to the pertechnetate form over time. The material itself consists of a yellow-orange liquid (approximately 700 microliters). This supernatant was pipetted into an NMR tube, and a conventional experiment was performed. Initial spectral results indicated only the presence of pertechnetate at a concentration of approximately 2.5×10^{-4} M. Signal from a Tc(IV) ion was not observed. In addition to the NMR studies, we performed a crude counting study to measure the total technetium. This study also indicated a level of approximately 2.5×10^{-4} M. It appears that the vast majority of the Tc has reoxidized to the pertechnetate form. We will attempt this reduction to the Tc(IV) form in the next few reporting periods.

The ^{99}Tc NMR studies reported in the literature have demonstrated good sensitivity and reasonable spectral linewidths on a surprising number of molecules and complexes. These molecules have included both paramagnetic and diamagnetic species, and materials with technetium oxidation states that include 0, 1, 2, 3, 5, and 7. In addition, these molecules range in chemical shift range over approximately 8,000 ppm. However, only a small fraction of the possible molecular species of Tc have been characterized by NMR (i.e., the materials in the tanks may be considerably different from reported literature data). Furthermore, considering that each tank may have drastically different Tc compounds, writing a failproof automated computer algorithm to pick out the Tc peaks may be difficult. Therefore, we are going to approach the problem by using the peroxodisulfate oxidation or the peroxodisulfate/silver oxidation that has been successfully developed by Norm Schroeder on several tank wastes. This reaction has been demonstrated to go to nearly completion (i.e., greater than 99.5%) under the correct conditions.

The oxidation procedure, as it stands, calls for addition of the reagents and the application of 60°C for one hour. We will modify the reaction to run at 80°C and therefore require a maximum time of 15 minutes for the reaction to complete. The reaction (perhaps even at 60°C) may actually require less time than allotted. We will be able to follow this reaction as it progresses (by the actual NMR signal), perform some kinetics, and minimize the required reaction time.

This reaction will be implemented in a continuous or stop/flow fashion with milliliter-sized samples in the feed stream to the on-line NMR. The total reagents required will be less than 1 ml/hr. This preparation step may add as much as 15 minutes to the analysis time. However, by only looking for pertechnetate, we will be able to cut back on the NMR bandwidth, which will increase the signal-to-noise (S/N) ratio and increase

Continued

the sensitivity of the analysis significantly. To date, we have measured an 8-micromolar sample with a S/N ratio of 2 in less than 14 minutes.

We have received the reagents and are completing the laboratory setup to allow this oxidation procedure (batch runs) in our facility. We are planing to perform the first oxidation studies this month. We feel that this approach is robust and tremendously simplifies the analysis problem. Furthermore, it will be easily implemented in a plant environment.

PI: Stephen Dieckman, Argonne National Laboratory, (630) 252-5628

Mixed Wastes

Pre-Processing Characterization/Monitoring

Waste Inspection Tomography

Objective

This project will construct a transportable inspection system to characterize containers of radioactive waste by nondestructive evaluation and assay. The Waste Inspection Tomography (WIT) system is contained in a semitrailer that could be driven to various DOE sites. Containers of waste at these sites would be imaged and the radioactive components analyzed without opening or physically sampling the containers. The purpose of the system is to allow rapid, cost-effective reduction of the backlog of radioactive waste containers by characterizing them as safe for storage at approved underground sites, or else by determining if additional treatment is required before such storage. The development effort will involve integration of two forms of computed tomography, transmission and emission.

Progress

Cost estimates associated with WIT refinements under a proposed contract modification were prepared. The proposed additional work involves multi-detector active and passive computed tomography (A&PCT) and a bar-code reader for drum identification. The revised cost analysis was submitted to FETC in November. A kick-off meeting and a design review for planning purposes related to these upgrades are scheduled for early December at Bio-Imaging Research (BIR) with BIR, FETC, and Lawrence Livermore National Laboratory personnel.

PI: Richard Bernardi, Bio-Imaging Research, (847) 634-6425

FETC COR: Steve Cooke, (304) 285-5437

Nondestructive Examination and Assay of Drums Containing Transuranic Waste

Objective

This project will develop and integrate techniques for nondestructive examination and assay of drums containing transuranic (TRU) waste. The data output from the integrated system, consisting of X-ray, gamma-ray, and neutron interrogation methods, will be combined using computer data fusion techniques. The X-ray and gamma-ray inspection modalities are provided by the Waste Inspection Tomography (WIT) system developed under a separate DOE contract; neutron inspection will be provided by the Active Passive Neutron Examination Assay (APNEA) system, developed by Lockheed Martin Specialty Components. The integrated system will provide identification of the

waste matrix and its density distribution; location of gamma emitters and fissionable components; identification of isotopes; TRU waste localization; and total TRU waste quantification. An imaging computer interface will be developed for data fusion and presentation in a manner consistent with the Waste Isolation Pilot Plant Waste Acceptance Criteria and the Quality Assurance Program Plan.

Progress

Lawrence Livermore National Laboratory (LLNL) has begun to perform spectroscopy and active and passive computed tomography (A&PCT) assay on a voxel-by-voxel basis on the eight-drum Rapid Commercialization Initiative (RCI) data sets. Bio-Imaging Research (BIR) is beginning to form a volume-rendered visualization data set to allow for a quantitative data fusion presentation on a voxel-by-voxel basis with the same RCI data sets from both WIT and APNEA. Except for the graphite drums, APNEA and WIT have seven matching RCI drum data sets. BIR expects to receive, sometime in late December, the RCI spectroscopy data on a voxel-by-voxel basis from both LLNL (from WIT A&PCT) and TRUtech (from APNEA), so that BIR can provide a combined visual presentation of quantitative results. BIR's goal is to have this combined data available by January. BIR also received from TRUtech a second report related to the RCI drum data for drums other than the seven common drums.

PI: Donald Robertson, Bio-Imaging Research, (847) 634-6425

FETC COR: Steve Cooke, (304) 285-5437

DOE Laboratory/Industry Performance Demonstration Test

Objective

To facilitate the characterization of waste drums at DOE sites and to determine if additional nondestructive evaluation/nondestructive assay (NDE/NDA) technical development is needed, it will be necessary to establish the performance capabilities of the NDE/NDA technologies that will make those characterization measurements.

To accomplish this objective, a series of performance demonstration measurements will be conducted at Idaho National Engineering and Environmental Laboratory (INEEL) with selected participating technology holders. The results will be used to prepare two reports, one for EM-30 to use for equipment selection decisions and the other for EM-50 to determine the amount, if any, of additional development efforts to fund.

Progress

The first cycle of the demonstration was completed, as discussed in last month's report. Assay results were collected from the participants, and scoring of the results began. The preliminary analysis of the Bio-imaging Research Waste Inspection Tomography (WIT) system reported data was completed. The four samples examined were all

assayed and reported an accuracy and error acceptable within the requirements provided by the Waste Isolation Pilot Plant (WIPP) Quality Assurance Project Plan, Section 9.1. However, the result given for the pyrochemical salts sample was fortuitous because the WIT system does not measure isotopic information. The system currently used isotopics for weapons-grade plutonium. Had the test sample's values actually been lower, the WIT system would not have satisfied the accuracy and error requirements.

Scoring of the Canberra Segmented Gamma Scanner results is in progress. An interim report will be prepared next month detailing the preliminary scoring of the cycle one assay data.

The second cycle of the demonstration began this month. The Canberra High Efficiency Neutron Counter system was moved into the facility, and all utility hook-ups were installed. The system is performing various pretest calibration measurements and is anticipated to begin measurement of actual test samples on December 9. The second participant in cycle two is the IQ3 Canberra gamma system. This system will arrive on site on December 8, and set-up activities will begin.

PI: Mike McIlwain, Idaho National Engineering and Environmental Laboratory,
(208) 526-8130

Intelligent Inspection and Survey Robot

Objective

This project will develop and demonstrate a semi-autonomous vehicle to inspect drums or other containers stacked in rows in central storage facilities. The Autonomous Robotic Inspection Experimental System (ARIES) will autonomously enter and trace an inspection route while actively avoiding obstacles. A camera vision system will be used to assist in the inspection of drums and other containers. The vehicle will be designed to meet the operating environment constraints associated with typical mixed waste storage facilities.

In phase 1, the ability of a testbed robot subsystem to navigate and observe visual damage in a simulated drum storage area was developed and tested. Phase 2 involved integrating subsystems into a robot that can inspect drums while navigating through 36-inch-wide aisles. Phase 3, in progress, involves demonstrating a refined commercial unit at one or more drum storage facilities.

Progress

The system was handed over to Idaho National Engineering and Environmental Laboratory; it is expected that it will be used there for one year to assess the system's

long-term reliability and operability. The draft final report was received and is being reviewed. The contract ended November 30.

PI: Robert Pettus, South Carolina Universities Research and Education Foundation,
(864) 777-9569

METC COR: Vijendra Kothari, (304) 285-4579

Waste Process Monitoring and Controls

Real-Time Plutonium Monitoring

Objective

This project will develop a molten glass stream on-line, real-time monitor for quantifying the concentrations of transuranics and selected other metals produced by vitrification. The monitor will be based on thermal emission spectroscopy, a nondestructive, non-contact Infrared Spectroscopy (IR) technique that can be used to chemically analyze moving process streams. Preliminary tests in FY97 on a glass melter at Savannah River Site (SRS) showed that the monitor could measure the concentration of ytterbium, a spectroscopic surrogate for plutonium and americium. Savannah River has endorsed production of such a monitor. Starting in FY98, work will begin with a new end-user group at SRS, the Am-Cm Stabilization Project. The monitor will be used to measure americium, curium, and possibly certain other components in the glass stream produced by their stabilization line, which is expected to go into production in FY00. During FY98, a basic monitor system tailored to the Am-Cm Stabilization need will be built and demonstrated at SRS for the stabilization project staff during some of the prototype testing they plan for this year.

Progress

We continue to gather information from our new end-user group at Savannah River, the Am-Cm Stabilization Project. We are using this information in designing the on-line monitor to be built this year.

PI: John McClelland, Ames Laboratory, (515) 294-7948

Offgas and Effluent Monitoring

Development of a Multielement Metal Continuous Emissions Monitor

Objective

This project will combine the air - inductively coupled plasma (ICP) atomic emission continuous emissions monitor (CEM) being developed at Diagnostic Instrumentation and Analysis Laboratory (DIAL), Mississippi State University (MSU), with the High Resolution Interferometric Spectrometer (HiRIS) being developed by Ames Laboratory. The HiRIS was developed for monitoring the isotopic composition of actinides, providing the resolution and sensitivity of a 1.5-meter spectrometer in a much smaller, lighter, and cheaper device. This project will (a) assemble a version of this device, incorporating components for ultraviolet operation, for detection of EPA-regulated metals, (b) integrate it into the DIAL CEM, and (c) demonstrate the system, with the DIAL developer, at a test facility. The HiRIS is completely electronically tunable and will be equipped with extensive software control and analysis routines to enable sensitive and accurate calibration and continuous monitoring.

Progress

We continued work on an array-based spectrometer. We are examining available components and how they will meet our needs. Meanwhile, we continue to use an existing photodiode array to perform bench tests for optical design.

We replied to a request by Savannah River Technology Center staff to examine the application of our high-resolution spectrometer design to measuring isotopic composition of enriched uranium in a hot cell operation. The application is feasible, and we responded with a cost estimate for implementation.

PI: David Baldwin, Ames Laboratory, (515) 294-4748, dbaldwin@ameslab.gov

Metal Emissions Monitor for DOE Mixed Waste Thermal Treatment

Objective

This task will develop and demonstrate an instrument using laser-spark-emission spectroscopy (LASS) as a continuous monitor to measure metal emissions from offgas of thermal treatment units. The project will address several important issues for the instrument, including sensitivity (at ppb concentrations for metals governed under the clean air act), calibration, durability, reliability, and accuracy. The purpose of this development is to design, build, and test a field instrument at a DOE facility.

Progress

The project team participated in two field tests during November. Both tests were sponsored by other DOE program offices and demonstrate the leveraging of CMST program funding. The first involved the measurement of metal and other species particulates in oil and gas industry production facilities, specifically a gas turbine co-generation facility. This field test provided a useful test of the expanded single-shot analysis package. Fine particulates were targeted in both the exhaust stack and in the ambient air intake manifold. Submicron-sized single particulates of iron, magnesium, silicon, calcium, and sodium composition were detected. Additional laboratory calibration will enable reduction of the data to produce total concentration levels and particle-sized distributions. The second field test involved measurements of alkali, alkaline earth, and main transition metal species in the exhaust duct of a full-scale glass furnace. Data from both of these tests will be analyzed in upcoming months.

The data generated during the August Toxic Substances Control Act (TSCA) Incinerator field test were fully analyzed. A formal report was submitted to TSCA personnel for inclusion in the final test report. Comparison of laser-induced breakdown spectroscopy (LIBS)-based concentration values with Method 29 results revealed agreement ranging from within 7% to values nearly 70% too low for cadmium, chromium, mercury, and manganese. Non-detects were reported for most of the beryllium Method 29 results, with the LIBS values agreeing to within about 0.5 micrograms/dscm for reported Method 29 values. The LIBS values for lead revealed poor correlation with the Method 29 results and are attributed to stack concentration values below the LIBS detection limits.

PI: David Hahn, Sandia National Laboratories, (510) 294-3337, dwhahn@sandia.gov

Disposition of Facilities (D&D)

Metals and Pipes

Portable X-Ray, K-Edge Heavy Metal Detector

Objective

This work will develop improved nondestructive assay (NDA) techniques for detecting and quantifying uranium, plutonium, and other heavy metals. The work will focus on situations where these elements are located inside sealed containers or processing equipment. The approach to this problem is based on observing the K-edge absorption transition in X-ray transmission measurements. The technique will be developed to maximize sensitivity for detecting heavy metals, while minimizing measurement time.

Progress

Analysis of the data from the tests on the uranium fuel plates was completed, and a report on the results, entitled "X-ray, K-Edge Measurement of Uranium Concentration in Reactor Fuel Plates," is available. Copies were distributed to personnel at Idaho National Engineering and Environmental Laboratory and Westinghouse Savannah River Company, where characteristics of spent nuclear fuel must be verified for long-term storage of the fuel. K-edge analysis could provide accurate nondestructive measurements of the total uranium content in the fuel, which would be a useful factor in determining other characteristics such as enrichment and burnup.

PI: Joe Gray and Terry Jensen, Ames Laboratory, (515) 294-9745

Facility Characterization

Airborne and Ground-Based Laser-Induced Fluorescence

Objective

This project will further develop and test the capability of laser-induced fluorescence imaging (LIFI) techniques for detection of uranium, heavy metals, organic compounds, and vegetation stress. The project's major efforts are: (1) to develop an airborne LIF system for survey of large geographic areas, and (2) to develop a handheld LIF instrument for detection of uranium on surfaces during decontamination and decommissioning (D&D) operations. Specific tasks include: (1) handheld uranium survey tool development, (2) support for the Cooperative Research and Development Agreement (CRADA) with Disney/EPCOT Center, and (3) airborne LIF tests and evaluation.

Progress

Spotlight system. A list of remaining tasks was generated; some of these fixes and improvements will need to be made before the system is used again for demonstrations or data acquisitions.

Airborne system. The computer and laser pallets were returned from Ft. Rucker; the laser power supply, chiller, and disk drive rack remain in storage at Ft. Rucker until needed for the next field flight. We plan to thoroughly check system operation, correcting any bugs and making improvements to the system's performance before any future deployment. In particular, the laser/optical system will be stepwise reviewed to locate the source(s) of the observed sensitivity loss and make corrections. Much of the data from the September flights was analyzed, and we will use the results to calculate the system photon throughput. Once we complete more detailed radiometric calculations, we will be able to take the necessary steps to increase and optimize the system sensitivity.

Backpack system. The backpack computer system was breadboarded and integrated with the video frame grabber. We acquired images from an RS170 camera and displayed them to VGA and to RS170. The camera was reworked by EOSI and returned. Paperwork for the purchase requisition for the backpack laser was completed, and it was submitted to Big Sky. We spent much effort defining system details such as component placement, cabling, grounding, accessibility for servicing, etc., and developed a preliminary conceptual system design and a set of rendered sketches.

PI: John DiBenedetto, Special Technologies Laboratory, (805) 681-2240

Laser-Induced Fluorescence for Heavy Metals in Soils and Plants

Objective

This task will conduct a demonstration of the laser-induced fluorescence imaging (LIFI) technology for the detection of heavy metals in soils and plants in Poland. The handheld LIFI unit will be used to collect data from vegetation of interest within the test study area, as well as from experimental plots to be supplied by the Institute for Ecology of Industrial Areas (IETU) in Poland. The portable survey tool will be prepared (i.e., modified, assembled, and tested) for use in Poland. The Special Technologies Laboratory (STL) team will travel to Poland to take plant fluorescence data in various spectral bands at a chosen field site, and return to STL to analyze the collected data.

Progress

All of the data files acquired in Poland were reviewed for data integrity, and some qualitative review was performed. The next step is to compile a comprehensive spreadsheet of the data, which will include such qualities as wavelength bands and intensities, and to use this information during the data analysis. Once the data analysis is complete, we will write a brief final report.

Meanwhile, the portable computer of the laser-induced fluorescence spectroscopy (LIFS) system was sent to the manufacturer for repair, under warranty, of an intermittent problem that developed in the field; it was repaired and returned.

PI: John DiBenedetto, Special Technologies Laboratory, (805) 681-2240

Plant Stress Analysis Technology Transfer

Objective

The Hemispheric Center for Environmental Technology at Florida International University (FIU-HCET) will aid the transfer of the laser-induced fluorescence imaging (LIFI) technology to the agricultural private sector through a market survey. The market survey will help identify the key eco-agricultural issues of nations that may benefit from the use of sensor technologies developed by the OST. The principal region of interest will be the Western Hemisphere, particularly the rapidly growing countries of Latin America and the Caribbean.

HCET will assess LIFI's advancement with respect to the state of the art. It will also facilitate the recruitment of commercial partners. These partners will likely be existing providers of agricultural services in the region or service providers who wish to expand their businesses into the Latin American and Caribbean markets. The targeted outcome of this work is to facilitate the technology's implementation by a commercial entity.

Progress

This month, HCET personnel:

- Further investigated the previously generated matrix of each country's primary crops and exports to more easily identify each country's particular concerns.
- Continued to research other international agricultural associations and organizations, and contacted them to inquire about each country's agricultural activities, concerns, and problems.
- Spoke to personnel at each country's consulate in the U.S. to substantiate the agricultural problems and concerns.

PI: M. A. Ebadian, Florida International University, (305) 348-3585

Objective

Optical characteristics of plants are being measured to detect stress as an indicator of underlying problems such as chemical contamination of soil or groundwater at the DOE and other sites. This project will apply the results of those measurements to construction of a robot-mounted suite of remote sensors for greenhouse installation and testing at EPCOT Center in Walt Disney World.

The project will involve a public demonstration of DOE technology; DOE-industry and government interagency cooperation; and technology transfer, i.e., to the agricultural community. The final application of this technology will be remote monitoring of DOE sites for detection of uranium oxides and plant stress monitoring. Vegetational sites include clay caps and landfills, while uranium surveys include monitoring decontamination and decommissioning (D&D) sites.

Progress

All components arrived for the new plant growing system slated for installation next to the robotic arm. Once assembly is complete, a new targeting program will be developed, and plants will be transplanted to start the first preliminary run with the robot. One run is intended to act as a trial to permit testing of different methods of data acquisition before the actual experimental runs. We expect the system will be replanted with the new configuration by December 15. Additionally, the robot-mounted sensor suite is being modified to increase standoff distance from 18 inches to 24 inches. The field of view of the fiberoptic-coupled reflectance spectrometer will also be modified, from an approximately 1-inch diameter spot to a system giving a choice of both a 1-inch or 3-inch diameter spot.

The first repetition of the bean/zinc experiment was completed. Data were taken 14, 28, and 42 days after transplanting beans into silica sand and initiating zinc levels of 0, 0.15, 0.3, 20, and 40 mg/l. Preliminary analysis suggests that as zinc levels increased, the fluorescence increased. However, the data were highly variable, and a completed second repetition of the experiment will be required to acquire enough data to analyze properly. Second, each bean leaf is sampled only once, and it might be more appropriate to take two to three samples and average the spectra. Third, commercial-grade macronutrient salts were used for this first experiment, and it appears that a trace amount of zinc might be present in the commercial fertilizers such that severe symptoms are not developing on all leaves in the canopies in plants grown at 0 mg/l. In future microelement experiments, only reagent-grade nutrient salts will be used.

The second round of the bean/zinc experiment began November 25. The first harvest will occur December 9. Because weather and lighting conditions have significantly slowed plant growth, an additional week was added from transplant to first harvest to match the physiological age of the beans in the two repetitions of the experiment.

We have been exploring different sampling techniques to improve the quality of the data by reducing the high variability of the leaf measurements. Although the studies are still in progress, we believe that multiple measurements per leaf and multiple leaves per plant are required to get an accurate representation of the fluorescence from a given plant.

Dr. James Guikema of Kansas State University visited The Land on November 26 to discuss the possibility of collaborating with us on this DOE-funded remote sensing project. His background is in the biochemistry and fluorescence of protein synthesis associated with photosynthetic pathways. He agreed to assist the project by first helping to select the best suite of biochemical assays that can be done easily and still produce the necessary biochemical data to correlate against fluorescence. Furthermore, he agreed to help interpret the biochemical results of this research within the context of the effects of the stress treatments on the physiological processes of the plants.

Dynamac owner Diana MacArthur visited The Land on November 20. She was excited about the potential applications of laser-induced fluorescence imaging (LIFI) for environmental monitoring and remediation, two areas also important to the Dynamac Corporation.

PI: Gene Capelle, Special Technologies Laboratory, (805) 681-2252

Program Coordination

Characterization Crosscutting Program Field Coordination

Objective

This project provides field coordination and program support for Characterization, Monitoring, and Sensor Technology Crosscutting Program (CMST-CP) activities. It involves and contributes to identification of technology needs; assessment of technology requirements, capabilities, and limitations; promotion of technology integration; assessment of technology development opportunities; and program planning and implementation.

Progress

CMST FY98 multi-year program plan development. Paul Wang prepared a memo regarding the action plans for final production of the CMST FY98 Multi-year Program Plan and forwarded it to CMST team members. The memo contained lead assignments and guidance for creating the sections for the identified problem areas. Team members are working on their assigned sections.

Cost savings reports. Stephan Weeks submitted the cost savings reports for the BetaScint and Digface (alias Warthog) technologies. Regarding BetaScint, he continued to coordinate an effort to provide funding for work at Pantex to obtain valuable and accurate cost savings data for the development of the Innovative Technology Summary Report (ITSR).

Technical reviews. Wang reviewed a phase 1 topical report and forwarded his comments to the FETC COR for the project, as requested. He also reviewed the draft report entitled "Comparative Testing of Slurry Monitors" at the request of the project PI. In addition, Wang reviewed the draft innovative technology summary report for the "Laser-Induced Fluorescence Technology" and forwarded his comments to Linda Rieser, University of Cincinnati.

Support of program management:

- At the request of Dave Hippensteel, CMST-CP field program manager, Wang prepared a draft agenda for the CMST Kick-off meeting, scheduled for January 6 and 7 in Las Vegas. He also provided Hippensteel with information regarding funds transferred from Technical Task Plan NV08C261, "Solicitation for Monitoring Technologies," to complete the Bladon lysimeter task. In addition, Wang responded to Hippensteel's request to provide Jef Walker with information regarding the funding and responsibilities of the CMST-CP support staff.
- Weeks submitted a hardcopy and electronic file update package of the visuals associated with the CMST-CP projects to the Information for Decisions (IFD) Program (Susan Johnson, Office of Technology Integration, EM-54).

- At the request of Bryan Albers, Wang revised the CMST Program Accomplishment Brochure containing information about four technologies and forwarded the new version to him. Also at Albers' request, Wang provided information regarding some issues related to the TMS records.
- Dave Roelant estimated the amount of time he spent on project reviews during the past year and collected the same information from the rest of the CMST-CP team. He also drafted a response to a question regarding the active and passive computed tomography technology and sent it to DOE HQ to be forwarded to a scientist in Spain. In addition, he entered CMST-CP data into an Excel spreadsheet electronic file—all DOE/EM-50 program submissions will be rolled up into a single Program Baseline Summary Report. He also collected updated information on 10 CMST-CP technologies for inclusion in a DOE/OST report to Congress.
- Roelant discussed the need for waste retrieval systems with Savannah River Site personnel, particularly the applicability of acoustic techniques for measuring objects and radius of mixing in high-level waste tanks. He also discussed CMST-CP technologies with members of the Ohio, Rocky Flats, and Richland STCGs. In addition, he held discussions with Lawrence Stebbins of Fluor Daniel Fernald, Ron Staubly of FETC-Morgantown, and Peter McMaster of O'Brien and Gere Companies regarding characterization technologies, both state-of-the-art and needs across the DOE Complex.
- Roelant collected information regarding the Cone Penetrometer Testing (CPT) sensor and sampler performance testing program for FY97 and FY98 and the availability of the DOE-owned Cone Penetrometer Truck at Savannah River.
- The Special Technologies Laboratory and PAI CMST team members participated in the CMST-CP team conference calls as directed.

Support for defining requirements for evaluation and testing of radiological sensor and robotic platform techniques. Paul Hurley traveled to Waterways Experiment Station (WES) to help the WES group prepare a dual-sensor probe for a series of cone penetrometer measurements to demonstrate its capability for planned measurements at Hanford. The probe is comprised of a sensor for gamma rays and a sensor for fluorescence X-rays. Several DOE representatives attended a meeting at WES regarding the program and also observed the pushes, which were made at Mississippi State University (MSU), about three hours away from WES. The measurements were made at MSU because a radioactive source was used to excite the X-rays, and the WES health physics department was not given enough time to prepare for approval to insert a source in the ground. The measurements were completed successfully, and good gamma-ray and X-ray data were obtained.

Hurley also attended a meeting of the Nuclear Science Symposium of the Institute of Electrical and Electronic Engineers (NSS/IEEE), where the emphasis appeared to be on the design and use of small solid state detectors.

Support of D&D activities. Roelant attended a D&D Focus Area Review meeting in Morgantown, November 4 to 6, during which he gave a presentation and answered questions regarding characterization technologies. Roelant also worked on the D&D need for asbestos monitors for DOE sites. In addition, he began writing a summary for an article on D&D characterization and monitoring for the Spectrum '98 conference.

Facilitator/technical monitor activities. In his role as facilitator, Weeks contacted the PIs of his assigned projects to obtain project information relevant to his facilitator presentation at the CMST Kick-off meeting in January. He collected similar information from the projects he is assigned to as technical monitor. Weeks also received a collaboratively written paper on hot cell work from Kevin Kyle, PI for the now closed-out "Neural Network Raman Cone Penetrometer Signal Extraction and Enhancement" project.

Technical information request. At the request of Kira Lynch of the U.S. Army Corps of Engineers (USACE), Paul Wang provided her with the information for her presentation at the Innovative Environmental Technologies Workshop scheduled for December 9 in Seattle. The information included a list of CMST-CP FY98 projects with individual PI contact information and a list of Innovative Technology Summary Reports related to characterization and monitoring technologies. The workshop, jointly sponsored by the USACE and the Interstate Technology Regulatory Cooperation (ITRC), was on identifying and eliminating government barriers to the use of innovative technologies. Ms. Lynch was the invited speaker on CMST-CP technologies.

Hardcopy and electronic publications:

- Tiffany Zachry and Weeks prepared the October CMST Monthly Progress Report with selected highlights and distributed 68 hardcopies to DOE managers and other interested parties. The report is also posted on the CMST Internet site (www.cmst.org), in both HTML and PDF format, under Reports & Publications.
- Zachry submitted highlights regarding CMST-related activities for consideration of inclusion in the OST Weekly Highlights publication.

PI: Paul Wang, Special Technologies Laboratory, (805) 681-2265

Characterization Crosscutting Program Technical Support

Objective

This task provides technical support and assistance in field coordination and program support for the Characterization, Monitoring, and Sensor Technology Crosscutting Program (CMST-CP). It involves and contributes to identification of technology needs; assessment of technology requirements, capabilities, and limitations; promotion of

technology integration; assessment of technology development opportunities; and program planning and implementation. Bill Haas and Glenn Bastiaans work as members of the combined DOE Headquarters (HQ) and field CMST-CP management and implementation team, providing technical and other support, as directed, to the CMST-CP HQ Program Manager and the CMST-CP Program Coordinator.

Progress

CMST-CP technical support to the Mixed Waste Focus Area (MWFA):

- *DOE incinerator operators' workshop.* Haas attended and assisted John McFee of the IT Corporation in facilitating the DOE Incinerator Workshop on Compliance with the EPA Proposed MACT (Maximum Achievable Control Technology) Rule. The workshop was held in Newport Beach, California, on November 4, the day preceding the annual meeting of the National Technical Workgroup (NTW) for Mixed Waste Treatment. The purpose of the workshop was to gather direct input and guidance from DOE incinerator operators concerning common problems and R&D efforts that may be needed to support operation in compliance with the EPA-proposed MACT rule. The participating incinerator operators, incinerators, and sites included: Charles McVay, Consolidated Incineration Facility, Savannah River Site (SRS); Fidel Perez, Toxic Substances Control Act (TSCA) Incinerator, Oak Ridge; and Dennis Conley, Waste Experimental Reduction Facility (WERF), Idaho National Engineering and Environmental Laboratory.
- *NTW meeting.* On November 5 through 7, Haas participated in the annual meeting of the National Technical Workgroup for Mixed Waste Treatment in Newport Beach, California. Haas co-authored two presentations given at the meeting:
 - “Air Pollution Control Status and Needs for Thermal Treatment Systems,” by Nick Soelberg and Peggy Knecht, Lockheed Martin Idaho Technologies Co. (LMITCO), and Haas. Soelberg presented.
 - “EPA/DOE Field Test Results of Continuous Emissions Monitors,” by Dan Burns, Westinghouse Savannah River Co. (WSRC); Haas; Steve Priebe, LMITCO; and Nina Bergan French, Sky+. Burns and French presented.

While at the NTW meeting, David Eaton, Haas, and others of the CEM Working Group helped set up a request from Dennis Conley of the WERF incinerator to EPA and the MWFA to provide a small group of dioxin experts to visit the WERF site. The experts were asked to analyze the incinerator configuration, test conditions, and other parameters, with the objective of developing a better understanding of dioxin/furan formation and measurements at the site. The goal is to establish operating configurations and conditions that will provide compliance with the EPA proposed MACT rule. The WERF Dioxin Value Engineering Workshop occurred November 13.

- Haas requested the latest manufacturer's information on Fast Gas Chromatography/Mass Spectrometry (GC/MS) from George Jarvis of Thermedics, Inc. After receiving the information, Haas shared and discussed the contents with Pete Castle, LMITCO, as requested by Steve Priebe. Haas also sent Jarvis a copy of the paper, "A Survey of Continuous Emissions Monitoring Technologies for Organic Compounds, Total Chlorine, and Ammonia," given at the 1996 International Conference on Incineration and Thermal Treatment Technologies. In that paper, Haas et al suggested the Fast GC/MS might be useful for continuous (or nearly continuous) monitoring of dioxins/furans.
- *September 1997 multi-metals Continuous Emissions Monitors (CEMs) test at EPA Research Triangle Park (RTP).* Haas reviewed the draft report submitted by J. P. Singh, Diagnostic Instrumentation and Analysis Laboratory (DIAL), Mississippi State University, regarding the performance of the DIAL laser-induced breakdown spectroscopy (LIBS) instrument during the September 1997 CEM test at the EPA RTP facility. In a November 12 email to Singh, Haas requested that the final report include additional narrative (and perhaps sketches) to help provide more complete descriptions of the procedures employed during the testing at EPA. Key procedures for which complete descriptions are needed include: calibration and zero check procedures, including the assumptions and equations employed, use of the background signal to correct the LIBS signal, application of "calibration factors," and determination of minimum detectable concentration levels and their associated relative precision and relative accuracy values.
- *Performance testing of multi-metals CEMs.* Haas completed work on the report of the April 1996 multi-metals CEMs test, "Performance Testing of Multi-Metal Continuous Emissions Monitors." The report, designated U.S. DOE R&D Report # IS-5128, was forwarded to Steve Priebe, INEEL, on November 21 for publication on the MWFA web site. The report will also be printed for conventional distribution.
- *WM '98 paper on overview of continuous emissions monitoring development.* Haas completed preparation of the draft presentation materials (visuals) and outline for the paper, "Overview of Development in Continuous Emissions Monitoring for Mixed Waste Treatment," to be presented in March at the WM '98 conference. Haas provided the draft materials by email to the session chair, Leon Borduin, Los Alamos National Laboratory (LANL), and to the co-authors, Dan Burns, Nina French, David Hutchins, Paul Lemieux, and Steve Priebe, for review and feedback on November 21.
- *WM '98 paper.* Haas completed the draft paper, "Overview of Development in Continuous Emissions Monitoring for Mixed Waste Treatment," and forwarded the same by email on November 29 to the WM '98 session chair and to the co-authors. The paper is in near-final form, but additional results from the September 1997 multi-metals CEMs tests at the TSCA incinerator and EPA RTP still need to be

included. Those results were not available before the WM '98 deadline for submission of the draft paper, but they can be included any time before the WM '98 publication deadline.

CMST-CP technical support to the Tanks Focus Area (TFA):

- Glenn Bastiaans spent considerable time this month supporting the CMST contribution to the TFA technical task plan (TTP) review. Information packages on seven TFA-related CMST technologies were transmitted to TFA personnel for their use in preparing presentation materials for the review. The draft presentation materials were reviewed, and comments were transmitted.
- Bastiaans attended the TFA TTP review meeting November 18 to 20 in Richland, Washington. In addition to providing support for the presentation of the TFA-related CMST technology development projects, Bastiaans discussed technology development and deployment plans of mutual interest to TFA and CMST. Liaison was established with several members of the TFA technical support teams as well as with some user representatives attending the review.
- *Comparative testing of tank slurry monitoring technologies.* Haas reviewed the draft final report on this subject prepared by Tom Hylton et al, Oak Ridge National Laboratory (ORNL), and provided constructive written comments to Hylton. The higher level comments and recommendations were provided by email (and copied to CMST and TFA team members, David Hippensteel, Paul Wang, Glenn Bastiaans, and Tom Thomas). Haas provided Hylton with detail-level comments and recommendations via a marked-up hard copy of the draft report sent by express mail on November 18.
- CMST and TFA team members including Haas and Bastiaans are reviewing the results of the comparative testing of tank slurry monitoring technologies as reported by Tom Hylton, ORNL. They are evaluating the needs and options for additional development of tank slurry monitoring instrumentation. Bastiaans and Tom Thomas of the TFA are planning to visit Shu-Haw Sheen, Argonne National Laboratory, on December 17. They will then help formulate a recommendation concerning possible future development of tank slurry monitoring instrumentation.

Support for CMST-CP program management:

- Haas and Bastiaans participated in CMST-CP team conference calls on November 12 and November 26. Topics addressed included: designation of CMST-CP HQ lead, preparation of Multi-Year Program Plan, Decontamination and Decommissioning (D&D) Focus Area and TFA program reviews, additional cost savings analysis work, and funding holdbacks.
- As requested by David Roelant of the CMST-CP support team, Haas and Bastiaans provided constructive comments and input for the draft CMST-CP contribution to the DOE-EM Project Baseline Summary (PBS) for OST on November 1.

- As requested by David Roelant on behalf of Jef Walker and Steve Lien, Haas and Bastiaans provided estimates of the time they spent on review activities in the past year. Times were estimated for four types of reviews: project reviews, proposal reviews, document reviews, programmatic reviews. The estimates were forwarded to Roelant on November 17.
- As requested by David Hippensteel, Bastiaans provided input concerning preparation of the CMST-CP Multi-Year Program Plan to Paul Wang.
- Bastiaans and Haas began writing sections of the CMST-CP Multi-Year Program Plan in the areas of high-level waste and mixed waste, respectively. Drafts are scheduled for completion and delivery to Paul Wang on or before December 12.
- Bastiaans participated in other support activities including: an additional planning conference call as part of the Rapid Commercialization Initiative; planning of a demonstration of the E-smart sensor system as part of the Defense Advanced Research Projects Agency Technology Reinvestment Program collaboration; continued consultation with the Hemispheric Center for Environmental Technology (HCET) at Florida International University on their CMST-related technology development projects; and conference call participation with the Chicago Operations Office Site Technology Coordination Group (STCG) needs committee.
- Haas continued to support the preparation of cost savings analysis reports for the deployment of innovative technologies. Please see last month's report. For the draft cost savings analysis report for Direct Sampling Ion Trap Mass Spectrometry (DSITMS), Haas requested information from Carol Eddy-Dilek regarding actual field applications of the DSITMS. The cost analyst, Jay Gunderson, Energy and Environment Research Center, University of North Dakota, requested the same information from Marcus Wise, ORNL. For the draft cost savings analysis report on the use of continuous emissions monitors, Haas faxed copies of the overheads used by Phil Gray of LMITCO for Gray's talk, "Considerations in Waste Analysis Plans for the Waste Experiment Reduction Facility (WERF)—Applicants Perspective," to Gunderson. Haas also sent contact information to Gunderson for the persons responsible for operation of DOE mixed waste incinerators at INEEL, Oak Ridge, and Savannah River. Contact with those persons is expected to be useful in establishing baseline costs for the cost savings analysis being performed for the continuous emissions monitoring technologies.

Support to DOE Office of Energy Efficiency and Renewable Energy (EE). At the request of Eric Lightner, DOE EE Office of Industrial Technology, on November 12 Haas provided a table of information concerning 19 currently funded projects (DOE EM and other sponsors) that have applicability to DOE EM waste treatment process and emissions monitoring needs. For each project, the table identified the PI, organization, project title and brief technical description, and sponsoring organization.

PI: Bill Haas, Ames Laboratory, (515) 294-4986